

CLAIMS

What is claimed is:

- Subj. Inv.*  
1. An object sorting system for automatically inspecting a plurality of objects and sorting acceptable objects from defective objects, the system comprising:

a feed conveyer for receiving a first plurality of objects, the feed conveyor moving the first plurality of objects through an inspection area;

a barrier placed across a top surface of the feed conveyer, wherein the barrier defines a boundary of the inspection area and is configured to redirect the first plurality of objects and cause the first plurality of objects to rotate about an object axis;

a sorting camera positioned for capturing an image of each of the first plurality of objects as the first plurality of objects rotate and move through the inspection area;

at least one final rejection valve, the at least one final rejection valve functioning to separate finally defective objects and inspected acceptable objects; and

a processor coupled to the feed conveyer, the sorting camera and the at least one rejection valve, wherein the processor executes an inspection routine that controls a speed of the feed conveyer, a scanning rate of the sorting camera and actuation of the at least one final rejection valve.

2. The system of claim 1, wherein an angle at which the barrier is placed across the feed conveyor is adjusted in conjunction with the speed of the feed conveyor to achieve a desired rate of rotation for the first plurality of objects.

3. The system of claim 1, wherein the first plurality of objects are one of a bolt, an engine valve, a capsule, a ball bearing and a medical ball.

4. The system of claim 1, wherein the first plurality of objects include at least one surface that is substantially cylindrical.

5. The system of claim 1, wherein the first plurality of objects are substantially spherical.

6. The system of claim 1, further including:

a cup conveyor including a plurality of open-ended cups, wherein each of the plurality of open-ended cups receives one of a second plurality of objects and transports its associated object through an intermediate inspection area, wherein the number of the second plurality of objects is greater than or equal to the number of the first plurality of objects;

a first inspection camera for capturing an image of a first end of each of the second plurality of objects as the second plurality of objects move through the intermediate inspection area;

a second inspection camera for capturing an image of a second end of each of the second plurality of objects as the second plurality of objects move through the intermediate inspection area, wherein the second end of each of the second plurality of objects is opposite the first end of each of the second plurality of objects;

at least one intermediate rejection valve, the intermediate rejection valve functioning to direct an intermediately defective object with at least one defective end such that the intermediately defective object is separated from an inspection stream, wherein the cup conveyor, the first and second inspection cameras and the at least one intermediate rejection valve are coupled to and controlled by the processor; and

a direction chute for receiving the objects with acceptable ends and directing them onto the feed conveyor.

7. The system of claim 1, wherein the barrier includes a wire.

8. The system of claim 1, wherein the barrier includes at least one pair of substantially parallel wires that contain the plurality of objects.

9. The system of claim 6, further including:

a hopper for receiving the second plurality of objects, the hopper providing the objects to the cup conveyor responsive to the processor.

10. The system of claim 6, wherein the sorting camera and the first and second inspection cameras are charge-coupled device (CCD) cameras.

11. The system of claim 1, wherein the sorting camera and the first and second inspection cameras are complementary metal-oxide semiconductor (CMOS) cameras.

12. The system of claim 6, further including:

a plurality of electric motors coupled to the processor, the plurality of electric motors for driving the feed conveyer, the cup conveyor, and the hopper responsive to the processor; and

a plurality of encoders coupled to the processor, the encoders providing an indication of the speed of an associated one of the motors and hence the associated speed of the feed conveyor and the cup conveyor, wherein the processor sets a sorting scan rate for the sorting camera responsive to the speed of the feed conveyor and an inspection scan rate for the first and second inspection cameras responsive to the speed of the cup conveyor.

13. A method for automatically inspecting a plurality of objects and sorting acceptable objects from defective objects, the method comprising the steps of:

receiving a plurality of objects;

rotating and moving the objects through an inspection area;

capturing an image of each of the plurality of objects as the plurality of objects move through the inspection area;

comparing the captured image of each of the plurality of objects to at least one stored image to determine whether an object is defective; and

directing a defective object such that the defective object is separated from inspected acceptable objects.

14. The method of claim 13, wherein the plurality of objects are rotated by a barrier which is placed across a feed conveyor that moves the objects through the inspection area, and wherein the angle at which the barrier is placed across the feed conveyor is adjusted in conjunction with the speed of the feed conveyor to achieve a desired rate of rotation for the plurality of objects.

15. The method of claim 13, wherein the plurality of objects are one of a bolt, an engine valve, a capsule, a ball bearing and a medical ball.

16. The method of claim 13, wherein the plurality of objects include at least one surface that is substantially cylindrical.

17. The method of claim 13, wherein the plurality of objects are substantially spherical.

18. An capsule sorting system for automatically inspecting a plurality of capsules and sorting acceptable capsules from defective capsules, the system comprising:

a feed conveyer for receiving a first plurality of capsules, the feed conveyor moving the first plurality of capsules through an inspection area;

a barrier placed across and above a top surface of the feed conveyer, wherein the barrier defines a boundary of the inspection area and is configured to redirect the first plurality of capsules and cause the first plurality of capsules to rotate about a capsule axis;

a sorting camera for capturing an image of each of the first plurality of capsules as the first plurality of capsules rotate and move through the inspection area;

at least one final rejection valve, the at least one final rejection valve functioning to separate finally defective capsules and inspected acceptable capsules; and

a processor coupled to the feed conveyer, the sorting camera and the at least one final rejection valve, wherein the processor executes an inspection/routine that controls a speed of the feed conveyer, a scanning rate of the sorting camera and the at least one final rejection valve.

19. The system of claim 18, wherein an angle at which the barrier is placed across the feed conveyor is adjusted in conjunction with the speed of the feed conveyor to achieve a desired rate of rotation for the first plurality of capsules.

20. The system of claim 18, wherein the first plurality of capsules are one of a bolt, an engine valve, a capsule, a ball bearing and a medical ball.

21. The system of claim 18, wherein the first plurality of capsules include at least one surface that is substantially cylindrical.

22. The system of claim 18, wherein the first plurality of capsules are substantially spherical.

23. The system of claim 18, further including:

a cup conveyor including a plurality of open-ended cups, wherein each of the plurality of open-ended cups receives one of a second plurality of capsules and transports its associated capsule through an intermediate inspection area, and wherein the number of the second plurality of objects is greater than or equal to the number of the first plurality of objects;

a first inspection camera for capturing an image of a first end of each of the second plurality of capsules as the second plurality of capsules move through the intermediate inspection area;

a second inspection camera for capturing an image of a second end of each of the second plurality of capsules as the second plurality of capsules move through the intermediate inspection area, wherein the second end of each of the second plurality of capsules is opposite the first end of each of the second plurality of capsules;

at least one intermediate rejection valve, the at least one intermediate rejection valve functioning to direct a defective capsule with at least one defective end such that the defective capsule is separated from capsules with acceptable ends, wherein the cup conveyor, the first and second inspection cameras and the at least one intermediate rejection valve are coupled to and controlled by the at least one processor; and

a direction chute for receiving the capsules with acceptable ends and directing them onto the feed conveyor.

24. The system of claim 18, wherein the barrier includes a wire.

25. The system of claim 18, wherein the barrier includes at least one pair of substantially parallel wires that contain the first plurality of capsules.

26. The system of claim 18, further including:

a hopper for receiving the second plurality of capsules, the hopper providing the capsules to the cup conveyor responsive to the processor.

27. The system of claim 23, wherein the sorting camera and the first and second inspection cameras are charge-coupled device (CCD) cameras.

28. The system of claim 18, wherein the sorting camera and the first and second inspection cameras are complementary metal-oxide semiconductor (CMOS) cameras.

29. The system of claim 23, further including:

a plurality of electric motors coupled to the processor, the plurality of electric motors for driving the feed conveyer and the cup conveyor responsive to the processor; and

a plurality of encoders coupled to the processor, the encoders providing an indication of the speed of an associated one of the motors and hence the associated speed of the feed conveyor and the cup conveyor, wherein the processor sets a sort scan rate for the sorting camera responsive to the speed of the feed conveyor and an inspection scan rate for the first and second inspection cameras responsive to the speed of the cup conveyor.